

irrigation water for the coming crop season. Rain and melting snow during the winter have caused the soil in the regions which supply water for irrigation purposes to become generally well saturated with water, which increases the favorableness of the prospects. Springs in the mountain region are increasing in the amount of running water.

Colorado.—There has been a general and material improvement in the outlook for late irrigation. Over a comparatively small area in the center of the State, in Lake, Summit, Eagle, and the northern part of Gunnison, where the Gunnison, Grand, and Arkansas rise, the totals were considerably less than normal, but in general other parts of the mountain region appear to have had the normal amount or an excess. Exceptionally low temperatures have been a feature, and even on the sunny slopes there has been but little melting. The action of the winds will also be a factor in conserving the moisture, for the bulk of the current fall has been swept into huge drifts in the timber, gulches, etc., where it is likely to remain hard packed and practically solid ice until after later snowfalls have been melted.

Idaho.—February has contributed little to the supply of snow, the month having been deficient in precipitation over the entire State. However, while great extremes of cold have not been reached, the temperature has been uniformly lower than the average, so that while there has been a decrease in the depth of snow in the valleys the amount at higher elevations averages about the same as at the close of January. What little melting has taken place has only served to settle and pack the snow rather than to diminish its mass, so that in most sections the mountain gulches are well filled with hard, icy snow. In some sections high winds have formed drifts of great depths, which will further contribute to the uniformity of the waterflow.

Montana.—In numerous sections of Montana, especially to the west of the mountains, February was a cold month. The snowfall was deficient

over the greater portion of the State and general conditions have not changed materially since January 31. There is, however, a good supply of hard packed or solid snow that fell during the earlier part of the winter at the heads of most of the streams, and with few exceptions an ample supply of water would seem to be assured.

Nevada.—High winds drifted vast quantities of snow into the canyons and gulches where it is packed solid and in many localities nearly a hundred feet deep. The outlook for an abundance of water during the coming season is the best in many years.

New Mexico.—Reports from all sections of the Territory show that February brought more moisture than any February for many years past. The depth of snow lying on the ground at the end of the month ranged from 6 feet in the northern mountains to about a foot on the average in the Black Range country. The northeastern section of the Territory, which suffered so greatly from the protracted drought of last year, has had deep snows, covering all the plains to a depth of from 8 inches to 2 feet, and in the mountains of Union County to a great depth. Reports indicate that the snow is well packed in the ravines, thus insuring a steady supply. The streams are now carrying a good supply, and there is every prospect for an abundance of water for several months to come.

Utah.—The month was one of the coldest on record, and there was little or no loss of snow by melting. The snow continued to drift and pack nicely. As stated in the January bulletin, all sections of the State will have an abundant supply of water for irrigation throughout the whole of the coming crop season.

Wyoming.—Cold weather and a snowfall much in excess of the February normal was general over nearly every section of the State during the month.

SPECIAL CONTRIBUTIONS.

HAWAIIAN CLIMATOLOGICAL DATA.

By CURTIS J. LYONS, Territorial Meteorologist.

GENERAL SUMMARY FOR FEBRUARY, 1903.

Honolulu.—Temperature mean for the month, 67.3°; normal, 70.6°; average daily maximum, 73.2°; average daily minimum, 61.3°; mean daily range, 11.9°; greatest daily range, 20.0°; least daily range, 6°; highest temperature, 77°; lowest, 53°. The month was colder than any month on record—25 years.

Barometer average, 30.003; normal, 29.958; highest, 30.21, 16th; lowest, 29.66, 19th; greatest 24-hour change, that is, from any given hour on one day to the same hour on the next, 0.30, 18-19th; lows passed this point on the 10th and 19th; highs on the 6th and 16th.

Relative humidity average, 71.4 per cent; normal, 76.0 per cent; mean dew-point, 57.0°; normal, 62.5°; mean absolute moisture, 5.24 grains per cubic foot; normal, 6.24 grains.

Dew-point lowest on record. Low periods indicating also passage of cold wave, 10th to 14th, and 23d. Dew on grass, 8 mornings.

Rainfall, 5.86 inches; normal, 5.48; rain-record days, 12; normal, 15; greatest rainfall in one day, 2.14, on the 20th; total at Luakaha, 7.98; normal, 14.07; at Kapiolani Park, 4.44; normal, 4.89.

The artesian well level rose during the month from 35.06 to 35.25 feet above mean sea level. February 28, 1902, it stood at 33.80. The average daily mean sea level for the month was 9.66, the assumed annual mean being 10.00 feet above datum. For February, 1902, it was 9.89.

Trade wind days, 17, (5 NNE.); normal, 12; average force of wind during daylight, 2.7, Beaufort scale. Average cloudiness, tenths of sky, 4.7; normal, 4.9.

Approximate percentages of district rainfall as compared with normal; South Hilo, 82 per cent; North Hilo, 130; Hamakua, 82; Kohala, 85; Waimea, 80; Kona, 65; Kau, 60; Puna, 80; Maui, 100; Oahu, Honolulu, 100; Upper Nuuanu and Koolau, 60; Kauai, 42.

The heaviest rainfall reported for the month was at Puuohua, Hilo, 19.36. Heaviest 24-hour rainfall, 4.86, at Laupahoehoe, 23d.

Ewa, 50 feet elevation, reports 51° minimum temperature on the 10th; Waimea and Waiakoa, 44° lowest temperature; Hilo, 54°.

Rainfall data for February, 1903.

Stations.	Elevation.	Amount.	Stations.	Elevation.	Amount.
HAWAII.			OAHU.		
Hilo, e. and ne.	Feet.	Inches.	Punahou (W. B.), sw.	47	5.86
Waiakoa	50	9.18	Kulaokahua (Castle), sw.	50	4.23
Hilo (town)	100	8.46	Makiki Reservoir	120	4.81
Kaunama	1,250	9.02	U. S. Naval Station, sw.	6	2.45
Pepeekeo	100	8.23	Kapiolani Park, sw.	10	4.44
Hakalau	200	10.17	College Hills	175	5.58
Honohina	300	13.21	Manoa (Woodlawn Dairy), c.	285	7.77
Puuohua	1,050	19.36	Manoa (Rhodes Gardens)	360	9.42
Laupahoehoe	500	11.95	School street (Bishop), sw.		
Ookala	400	10.98	Insane Asylum, sw.	30	5.08
HAMAKUA, ne.			Kamehameha School	75	
Kukui	250	8.13	Kalihi-Uka, sw.	485	7.77
Paaui	300	6.55	Nuuanu (W. W. Hall), sw.	50	5.18
Paaui	300	5.04	Nuuanu (Wylie street)	250	
Honokaa (Mill)	425	5.24	Nuuanu (Elec. Station), sw.	405	5.23
Honokaa (Meinicke)	1,100		Nuuanu (Luakaha), c.	850	7.98
Kukuihaele	700	3.99	U. S. Experiment Station	350	5.69
KOHALA, n.			Laniakoa (Nahuia)	1,150	8.32
Niuli	200	3.53	Tantalus Heights	1,360	10.54
Kohala (Mission)	521	3.71	Waimanalo, ne.	300	2.84
Kohala (Sugar Co.)	270	3.35	Maunawili, ne.	300	5.02
Hawi, Mill	700	4.34	Kaneohe	100	3.63
Puakea Ranch	600	3.96	Ahuimanu, ne.	350	5.27
Puuhiue Ranch	1,847	4.75	Kahuku, n.	25	2.73
Waimea	2,720	3.68	Waialua	37	
KONA, w.			Wahiawa	900	
Holualoa	1,350	2.16	Ewa Plantation, s.	60	1.39
Kealahou	1,580	1.76	U. S. Magnetic Station	45	1.31
Napoo	25	1.85	Waipahu	200	1.59
Hoopu	1,650		Moanalua	15	6.12
KAU, se.			KAUAI.		
Kahuku Ranch	1,680	1.94	Lihue (Grove Farm), e.	200	2.07
Honoupo	15	1.00	Lihue (Molokoa), e.	300	1.80
Naalehu	650	1.31	Lihue (Kukaua), e.	1,000	4.14
Hilea	310	2.20	Kealia, e.	15	1.29
Pahala	850		Kilauea, ne.	325	2.36
Moaula			Hanalei, n.	10	4.78
Volcano House	4,000		Waioli	10	4.67
PUNA, e.			Haena	15	4.56
Olaa, Mountain View (Russell)	1,690	10.57	Waiawa	32	0.86
Kapoho	110	2.28	Eleele	150	0.89
Pahoa	600	10.16	Wahiawa (Mountain)	3,000	7.60
MAUI.			McBryde (Residence)	850	3.24
Lahaina	40	3.58	Lawai (Gov. Road)	450	3.46
Waipae Ranch	700	1.99	Lawai, w.	225	2.08
Kaupo (Mokulau), s.	285	6.63	Lawai, e.	800	3.16
Kipahulu, s.	308		Koloa	100	2.76
Nahiku, ne.			Delayed January reports.		
Nahiku	1,600	17.80	Kaunama		4.08
Haiku, n.	700	6.88	Niuli		4.10
Kula (Erehwon), n.	4,500	5.94	Holualoa		3.17
Kula (Waiakoa), n.	2,700	3.50	Nahiku	1,600	25.40
Puuomalei, n.	1,400		Haleakala Ranch		14.21
Paia	180	7.32			
Haleakala Ranch	2,000	11.79			
Wailuku, ne.	250	5.58			

NOTE.—The letters n, s, e, w, and c show the exposure of the station relative to the winds.

OBSERVATIONS AT HONOLULU.

The station is at 21° 18' N., 157° 50' W. It is the Hawaiian Weather Bureau station Punahou. (See fig. 2, No. 1, in the MONTHLY WEATHER REVIEW for July, 1902, page 365.) Hawaiian standard time is 10^h 30^m slow of Greenwich time. Honolulu local mean time is 10^h 31^m slow of Greenwich.

The pressure is corrected for temperature and reduced to sea level, and the gravity correction, -0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other. The rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m., Greenwich time, on the respective dates.

The rain gauge, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet and the barometer 50 feet above sea level.

Meteorological Observations at Honolulu, February, 1903.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m. Greenwich time, or 1:30 a. m. Honolulu time.								Total rainfall at 9 a. m., local time.			
		Dry bulb.	Wet bulb.	Temperature.		Means.		Wind.		Average cloudiness.	Sea-level pressures.				
				Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.		Maximum.		Minimum.		
1	*	†	†			†	†								
2	30.11	69	62.5	74	69	58.7	66	ene.	5	8	30.18	30.08	0.01		
3	30.12	70	63.5	74	67	59.5	68	ne.	4-5	7	30.16	30.10	0.03		
4	30.05	70	62.5	75	69	59.5	66	ne.	4-5	3-7	30.16	30.04	0.00		
5	30.03	68	64.5	75	69	60.0	70	ne.	4-5	8	30.09	30.01	1.35		
6	30.05	70	64	75	66	61.5	73	ne.	3-5	4-1	30.10	30.01	0.40		
7	30.14	70	63.5	75	67	60.5	73	ne.	5	6	30.19	30.06	0.45		
8	30.14	69	64.5	74	65	59.7	70	ne.	5	5	30.19	30.09	0.25		
9	30.07	71	66	74	67	63.7	78	ne.	5	5	30.16	30.05	0.10		
10	29.99	63	62.3	76	68	64.5	80	ne.	3-0	4-1	30.11	29.99	0.00		
11	29.93	56	55	77	62	64.0	80	ws-w.	0-3	0	30.00	29.87	0.00		
12	29.88	55	53.5	72	56	52.3	72	n.	0	0-1	29.94	29.81	0.00		
13	29.90	54	53	73	53	55.0	79	n-w.	0-2	2	29.95	29.85	0.00		
14	30.00	64	61.5	73	53	55.7	79	w.	2-0	2	30.02	29.93	0.00		
15	30.06	66	57.5	74	61	58.3	72	w-n.	0-4	10-1	30.06	29.96	0.00		
16	30.10	65	57.5	72	65	49.3	55	nne.	4	10-4	30.14	30.05	0.00		
17	30.16	68	58.5	72	63	54.0	64	ne.	3-4	4	30.19	30.11	0.00		
18	30.14	65	61	74	65	54.7	62	ne.	3	5	30.21	30.14	0.00		
19	30.06	61	57	72	61	56.7	67	ne.	3	6	30.19	30.07	0.00		
20	29.86	61	56.5	74	59	50.7	62	sw-n.	1-0	9-0	30.08	29.87	0.00		
21	29.66	61	58	69	57	56.5	81	sw-w.	3-0	10-3	29.87	29.66	2.14		
22	29.85	68	63	70	54	59.5	84	nne.	4	9-6	29.88	29.66	0.60		
23	29.90	66	64	73	64	60.7	76	ne.	4	8	29.96	29.84	0.50		
24	29.92	59	53.5	73	63	61.0	82	ne-n.	3-0	9-1	29.95	29.86	0.01		
25	29.92	56	54	70	54	49.0	61	nw.	2-4	5	29.95	29.85	0.02		
26	29.99	64	58	72	56	53.3	73	uw-n.	2-0	4	30.02	29.91	0.00		
27	29.95	61	59	72	56	55.7	71	n.	2	5	30.02	29.92	0.00		
28	30.00	63	59.5	73	61	54.3	68	nne.	3-0	1	30.05	29.93	0.00		
29	30.04	62	56.5	73	57	54.5	70	ne.	3	10-3	30.07	29.99	0.00		
30															
31															
Sums														5.86	
Means	30.001	64.1	59.6	73.2	61.3	57.0	71.4		2.7	4.7	30.064	29.954			
Departure	+0.045					-5.5	-5.0			-0.2				+0.38	

Mean temperature for February, 1903, (6 + 2 + 9) ÷ 3 = 67.3; normal is 70.6. Mean pressure for February, 1903, (9 + 3) ÷ 2 = 30.003; normal is 29.958.

* This pressure is as recorded at 1 p. m., Greenwich time. † These temperatures are observed at 6 a. m., local, or 4.31 p. m., Greenwich time. ‡ These values are the means of (6 + 9 + 2 + 9) ÷ 4. § Beaufort scale.

Maximum thermometer set at 9 p. m. and minimum at 2 p. m., local time.

Mean temperature table.

Stations.	Elevation.	Mean max.	Mean min.	Cor. av'ge.
Pepeekeo	100	74.0	63.9	68.3
Waimea	2,730	60.2	52.3	60.0
Kohala	521	73.6	61.5	67.0
Nahiku	1,600	67.5	59.0	62.5
Waikoa	2,700	70.0	50.8	60.1
Ewa Mill	50	76.5	60.0	67.6
United States Magnetic Station	50	76.4	59.7	67.3
United States Experimental Station	350	73.8	62.2	67.5
W. R. Castle	60	66.8
Tantalus	1,725
Hilo	40	76.6	62.0	68.6
Waikiki	15	73.1	63.8	68.0

Kohala, Bond, dew point, 58.4°; relative humidity, 73 per cent; Ewa Mill, 56° and 65; Magnetic Station, 57° and 71, same as Punahou.

As stated before, the month was the coldest on record, the dew-point also being the lowest. The marked disturbances of the month were about the 10th and 20th. Heavy surf, 1st-7th, 11th, and 21st. Snow on the 19th, 20th, and 23d. The first

fell as low down on the mountains, including Hualalai in Kona, as yet known, the previous recorded snowfalls on Mount Hualalai being in 1892 and 1863. Seven thousand feet elevation is about the lowest limit of snowfall on the Hawaiian mountains.

Electric storms on the 19th and 20th on Maui and Hawaii. Earthquakes, Hilo, 9th, 11:23 a. m., and 21st; Waimea, 4th, 10 p. m.; Kohala, 4th, 12:20 a. m.

The total rainfall at Nahiku, Maui, at 1600 feet elevation, for the twelve months from March 1, 1902, to February 28, 1903, 429.48 inches.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.
[For tables see the last page of this REVIEW preceding the charts.]

Notes on the weather.—On the Pacific slope the weather was quite normal for the season; i. e., hot, dry, and windy. For San José pressure and temperature were slightly above the normals, while the hours of sunshine show a large excess. On the Atlantic slope rain was rather scarce and the coast stations report several squalls with a stormy sea.

Earthquakes in San José.—February 1, 9^h 15^m a. m., light shock E-W, intensity I, duration 3 seconds. February 2, 12^h 33^m p. m., light shock N-S, intensity II, duration 5 seconds. February 3, 6^h 20^m a. m., rather strong and well-felt shock N-S, intensity III, duration 4 seconds. February 10, 6^h 07^m a. m., strong shock E-W, intensity III, duration 10 seconds. February 11, 4^h 49^m a. m., slight shock E-W, intensity II, duration 4 seconds. February 22, 3^h 05^m p. m., strong shock E-W, intensity III, duration 8 seconds. February 24, 8^h 22^m p. m., light shock E-W, intensity II, duration 4 seconds; 10^h 12^m p. m., slight shock E-W, intensity III, duration 6 seconds. Another shock, strong and dilated, is reported from Cachi and Paraiso, having been felt same day, 24th, at about 4 a. m. February 25, 6^h 06^m a. m., well-felt shock E-W, intensity III, duration 6 seconds. February 28, 4^h 09^m a. m., dilated tremors E-W, intensity III, duration 38 seconds; generally felt, frightening people. The same earthquake is officially reported from San Isidro de Alajuela.

THE TEMPERATURE AND RAINFALL DEPARTURES AT HAWAII, AS DUPLICATED IN NEW ENGLAND SIXTY DAYS LATER.

By ALTON D. ELMER, Northfield, Mass., dated February 11, 1903.

When the MONTHLY WEATHER REVIEW began publishing Curtis J. Lyons's Hawaiian observations it was said to be done for the benefit of those who wished to study for long-range seasonal predictions. I, therefore, inclose a copy (unverified for clerical errors) of some comparisons which I have just made, only extending them until I detected a correlation between the Honolulu monthly temperatures and those of New England two months later.

Table 1 shows that changes in the departures from monthly normals of rainfall in Honolulu are followed by corresponding changes in New England sixty days later, in a majority of cases, and the same holds good for the temperature departures.

Attention is called to the fact that the 60-day period, not only for precipitation but also for temperature, is much more marked as the records progress, thus confirming a suspicion that the whole difficulty in the earlier records was the want of good normals.

During 1902, rising or falling monthly temperatures at Hawaii were followed by increased or decreased precipitation in New England two months later, with the exception of but one and one-half months. The year 1902 was likewise remarkable in New England for having increased temperature accompany increased precipitation and decreased temperature accompany decreased precipitation every month but one. This is explanatory of the cold summer, corrected by a warm spring and a